

What is claimed is:

1. A decoupler assembly for transferring torque between a shaft and a drive belt, said decoupler assembly comprising:
  - a hub configured to be fixedly assembled to the shaft, said hub including a helical first slot formed therein;
  - a carrier rotatably mounted on said hub, said carrier including a helical second slot formed therein;
  - a torsion spring extending between a hub end and a carrier end for transferring torque between said hub and carrier, wherein said hub end is retained in said helical first slot to prevent relative movement between said hub end of said torsion spring and said hub and said carrier end is retained in said helical second slot to prevent relative movement between said carrier end of said torsion spring and said carrier;
  - a pulley rotatably coupled to said hub, said pulley having an outer periphery configured to frictionally engage with the drive belt, said pulley having an inner surface formed therein;
  - a clutch spring fixedly secured to said carrier and having a plurality of helical coils frictionally engaging with said inner surface of said pulley to selectively couple said hub and pulley, said torsion spring and said clutch spring wound in opposite senses enabling said clutch spring to expand into gripping engagement with said inner surface during acceleration of said pulley relative to said hub and to contract out of gripping engagement with said inner surface during deceleration of said pulley relative to said hub.
2. A decoupler assembly as set forth in claim 1 wherein said hub includes a body extending axially between first and second ends.

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ART 34 AND 7

3. A decoupler assembly as set forth in claim 2 wherein said hub includes a cylindrical outer surface extending between said first and second ends.
  4. A decoupler assembly as set forth in claim 3 wherein said hub includes a first flange extending radially outwardly from said body to define an outer flange surface having a larger diameter than said body.
  5. A decoupler assembly as set forth in claim 4 wherein said second flange includes an annular surface extending radially between said body and said outer flange surface.
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6. A decoupler assembly as set forth in claim 5 wherein said helical first slot is formed in said annular surface for retaining therein said hub end of said torsion spring for preventing relative movement between said hub end of said torsion spring and said hub.
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7. A decoupler assembly as set forth in claim 6 wherein said hub includes a reduced diameter portion having an outer mounting surface having a smaller diameter than said body of said hub.
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8. A decoupler assembly as set forth in claim 7 wherein said hub includes an abutment surface extending radially between said body and said outer mounting surface.
9. A decoupler assembly as set forth in claim 8 wherein said carrier is ring shaped and extends axially between opposite first and second sides.

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10. A decoupler assembly as set forth in claim 9 wherein said helical second slot is formed in one of said first and second sides of said carrier for retaining therein said carrier end of said torsion spring for preventing relative movement between said carrier end of said torsion spring and said carrier.

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11. A decoupler assembly as set forth in claim 10 wherein clutch spring extends between a hooked proximal end and an opposite distal end.

12. A decoupler assembly as set forth in claim 11 wherein at least one of said first and  
10 second ends of said carrier includes a hooked slot for retaining therein said hooked proximal end of said clutch spring to prevent relative movement between said hooked proximal end of said clutch spring and said carrier.

13. A decoupler assembly as set forth in claim 12 wherein said clutch spring is formed  
15 from an uncoated spring steel material.

14. A decoupler assembly as set forth in claim 13 wherein said clutch spring includes a non-circular cross-section to improve frictional engagement between said plurality of coils and said inner surface of said pulley.

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15. A decoupler assembly as set forth in claim 14 including a bearing member operatively assembled between said pulley and said hub for rotatably mounting said pulley on said hub.

16. A decoupler assembly as set forth in claim 15 wherein said decoupler assembly  
25 includes a first lubricant operatively associated with said bearing member for minimizing

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ART 34 AMDT

frictional wear therein and a second lubricant disposed between said clutch spring and said inner surface for minimizing wear therebetween, said second lubricant being compatible with said first lubricant such that said the decoupler continues to function if said first lubricant is displaced from said bearing member and mixes with said second lubricant between said

5 clutch spring and said inner surface.

17. A decoupler assembly as set forth in claim 16 wherein said bearing member includes a ball bearing assembly having an inner race engaging said hub and an outer race engaging said pulley.

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18. A decoupler assembly as set forth in claim 17 including a thrust washer seated on said outer mounting surface of said reduced diameter portion for axially compressing said torsion spring between said carrier and said hub.

15 19. A decoupler assembly as set forth in claim 18 wherein said inner race of said ball bearing assembly is press fit onto said outer mounting surface of said reduced diameter portion to retain said thrust washer against said abutment surface, whereby said axial compression of said torsion spring is maintained.

20 20 A decoupler assembly as set forth in claim 19 wherein said carrier includes a split to allow said carrier to flex and accommodate loads associated with rotation of said decoupler assembly.

21. A decoupler assembly for transferring torque between an engine driven crankshaft  
25 shaft and a drive belt, said decoupler assembly comprising:

REPLACED BY  
ART 34 AMDT

- a hub configured to be fixedly assembled to the crankshaft;
- a spring support fixedly secured to said hub, said spring support having a first tab extending outwardly therefrom;
- 5 a carrier rotatably mounted on said hub, said carrier having a second tab extending outwardly therefrom;
- a torsion spring extending between a hub end and a carrier end for transferring torque between said spring support and carrier, wherein said hub end includes a first notch engaged with said first tab to prevent relative rotation between said hub end of said torsion spring and said spring support and said carrier end includes a second notch engaged with said second tab
- 10 to prevent relative rotation between said carrier end of said torsion spring and said carrier.
- a pulley rotatably coupled to said hub, said pulley having an outer periphery configured to frictionally engage with the drive belt, said pulley having an inner surface formed therein;
- 15 a clutch spring fixedly secured to said carrier and having a plurality of helical coils frictionally engaging with said inner surface of said pulley to selectively couple said hub and pulley, said torsion spring and said clutch spring wound in opposite senses enabling said clutch spring to expand into gripping engagement with said inner surface during acceleration of said hub relative to said pulley and to contract out of gripping engagement with said inner surface during deceleration of said hub relative to said pulley.
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22. A decoupler assembly as set forth in claim 21 wherein said hub includes a body extending between first and second ends.

REPLACED BY  
ART 34 AMDT

23. A decoupler assembly as set forth in claim 22 wherein said hub includes a reduced diameter portion defining an outer mounting surface having an outer diameter smaller than said body.
- 5 24. A decoupler assembly as set forth in claim 23 wherein said hub includes an abutment surface extending between said outer mounting surface and said body.
25. A decoupler assembly as set forth in claim 24 including a flange having a mounting portion configured for fixedly mounting said flange onto said outer mounting surface.
- 10 26. A decoupler assembly as set forth in claim 24 wherein said flange includes a U-shaped cross section defined by an end wall extending between inner and outer flange walls.
- 15 27. A decoupler assembly as set forth in claim 26 wherein said carrier is retained between said inner and outer flange walls and said end wall, such that said carrier and said clutch spring rotate together with said flange.
- 20 28. A decoupler assembly as set forth in claim 27 wherein said pulley includes an inner flange portion having a U-shaped cross section defined by a connecting wall extending between outer and inner pulley walls.

29. A decoupler assembly as set forth in claim 28 wherein said spring support is retained between said outer and inner pulley walls and said connecting wall, such that said spring support rotates with said pulley.

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REPLACED BY  
ART 34 AMDT

30. A decoupler assembly as set forth in claim 29 including a thrust washer disposed between said mounting portion of said flange and said abutment surface for continuously biasing said first and second tabs of said spring support and carrier toward engagement with said first and second notches of said hub and carrier ends of said torsion spring, respectively.

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ART 34 AMDT